ORIGIN AND MODE OF OCCURRENCE OF GOLD-BEARING VEINS AND OF THE ASSOCIATED MINERALS.

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The interspaces between the boulders are filled with quartz and tetrahedrite (grey copper ore,) and this quartz has the appearance of being deposited from solution in a gelatinous state. Graphite occurs in cavities between the boulders. This deposit is thought by some to have been the site of a geyser or mineral spring carrying minerals in solution to its waters.

The El Callao Gold Mine, in Venezuelan Guiana, is one of the richest in the world. It is said to be in folstone, containing pyrites, the quartz of which the gangue consists, being white occasionally tinged with green. I have examined specimens from this mine, and they are very similar to some of the stone taken from the quartz veins in the Australasian Colonies. From 1871 to 1879 a total quantity of 67,362 tons of quartz is said to have been crushed from this mine for a return of 252,973 ounces of gold; and in 1880, 18,624 tons of quartz for 54,012 ounces of melted gold.

THE ORIGIN OF GOLD-BEARING VEINS.—In investigating the origin of gold-bearing veins, or the manner in which they are most likely to have been formed, I think the foregoing notes have shown that they have so much in common with other mineral lodes, as regards their actual physical peculiarities and the manner in which they occur in the rocks, that we may consider them to have been formed under very similar circumstances, and are dependant to a great extent upon the same laws of nature for their modes of occurrence.

In seeking therefore to determine the most probable manner in which gold veins and other mineral lodes have been formed, it will be well first to mention some of the different theories that have been propounded on the subject, and after having briefly referred to the various arguments for and against each of these, to consider which, if any, have the best claim to be accepted as most applicable and best able to account for the various phenomena observed in connection with the occurrence of metalliferous lodes, and more particularly those in which gold is the most prominent metal. The various theories proposed may be classed under the following heads:—1 Igneous injection, 2 Sublimation, 3 Aqueous ascension, 4 Aqueous solution, 5 Lateral secretion, 6 Molecular aggregation, 7 Electrical currents.

The theory of igneous injection supposes that the quartz or other matrix of the veins or lodes together with the contained metals or minerals has been forced into fissures, cracks or cavities, caused in most cases by the same igneous force that injected the vein matter, and that these having become solidified in the fissures, the lodes were thus formed. It therefore supposes the formation of veins and lodes to have taken place very rapidly, and in close proximity to violent volcanic disturbances.

The sublimation theory considers that vein fissures were filled by the condensation of volatilized metals and minerals derived from some portion of the interior of the earth where intense heat prevailed.

The advocates of the *aqueous ascension theory* argue that the mineral waters containing the metals in solution have risen in fissures or cracks in the earth, and precipitated their contents upon the walls or sides of these fissures, (and in any cavities they could obtain access to,) until they were almost or entirely filled with lode matter.

Those who support the *aqueous solution theory* believe that all the contents of mineral lodes were washed in from above.

Lateral secretion accounts for the formation of most veins and lodes by stating that the rock enclosing the lodes contains in itself nearly or all the constituents of the veins, and that these have gradually accumulated in the lodes in consequence of water dissolving various minerals and metals from the country rock, and then after filtering through the walls of the fissure redepositing all or some of them.

Molecular aggregation considers that the minerals and metals of the veins have collected together in a somewhat similar manner to that in which minerals collect together in the crystalline rocks, for instance, like pegmatite in granite and the concentric layers in orbicular diorite.

Those who support the *electrical* hypothesis, say that both the formation of the fissures and the collection of the minerals in them could be produced by electrical action.

The advocates of each of these several theories have proved to a certain extent the possibility of veins of minerals being formed in accordance with their views, and interesting have been the experiments made to support their arguments. Magnetite for instance has been formed by sublimation in reverberatory furnaces as well as in volcanic fissures, and Daubrée succeeded with the aid of fluorine in forming tin ore, oxide of titanium, and quartz by sublimation. Durocher passed gases and metallic vapors into heated glass tubes and obtained crystals of blende, iron pyrites, galena, sulphite of silver, sulphite of antimony, and sulphate of bismuth. Electricity is shown to be capable of creating fissures and filling them with metals by an experiment made by Mr. R. W. Fox, who produced fissures in clay and filled them with metallic substances by means of electrical currents generated artificially.

Water under heat and pressure has been shown to dissolve or decompose certain minerals and redeposit their constituents or some of them in other mineral forms.

Fissures are known, such as the Steam Boat Springs, about fourteen miles from the Great Comstock Lode, that are in the actual process of being filled with a deposit from heated water and vapors. Veins of crystallized mineral have been found in cracks in the masonry in the bottom of a furnace, either through injection of the metals composing them in a molten state, or by sublimation, and every one with any chemical knowledge knows how metallic compounds can be produced in the laboratory by precipitating metals from solution, and how these may be redissolved and deposited again in other mineral forms.

(To be Continued.)